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Rubber Asphalt Test Roads Progress Report 1981

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1/ INTRODUCTION

Our present civilized society is producing more than 10 000 000 used rubber tires annually in Canada. The disposal of these tires is an environmental problem. Only a small percentage of this used rubber can be shredded and used for blending in the production of new rubber. The remainder cannot be burned because it would cause air pollution and the tires cannot be buried because frost action brings them back to the surface. One suggested method for the disposal of these old tires is to grind them up and use the rubber in asphalt roads.

A considerable amount of research work has been done by the Phoenix, Arizona Department of Transport on using rubber dispersed in asphalt for surface treatments [1,2]. The process developed involves soaking the ground rubber in the asphalt cement for up to two hours. This is done in specially designed distributors fitted with special agitating and heat transfer equipment. This blend is then sprayed on the road to be surface treated, covered with stone, and rolled. Some of these surface treatments are now nearly ten years old. The rubber-asphalt film has remained very elastic and reflection cracking has not occurred on some areas which had previously shown severe flexural cracking.

Some years ago, Mr. J. George of Metro Roads (Toronto) saw the work being done in Phoenix and sponsored a research project at the University of Toronto under Professors Woodhams and Piggott to develop a formula for using rubber in asphaltic concrete. Formulae for such usage have since been developed and published [3,4,5, and 6]. Several test roads have been laid by Metro Toronto and these appear to be performing well.

The researchers at the University of Toronto claim that in order to obtain the benefits of rubber in asphalt, the binder content of the mix should be increased by about 2%, for example, from 6% to 8%. Their findings show that rubber asphalt mixes have greater flexibility, greater "toughness", and should oxidize at a slower rate. The higher binder content of the mixes does not appear to cause flushing. This has been demonstrated in the test roads Metro Toronto has laid. These roads have been sampled by Ministry of Transportation and Communications and all appear to be in good condition.

The Ministry of the Environment is also interested since this process will provide a means of removing from the environment the piles of old used tires, and the Ministry of Industry and Tourism (MIT) because it could bring another industry to the province; that of crushing and shredding the tires. MIT offered to cover the extra costs involved in laying two rubber-asphalt test roads of approximately one-half mile each in length on contracts where some new roads were being constructed. This was done on two paving contracts in 1980 and the test roads are now under observation.

2/ DESIGN OF THE TEST ROADS

Highway 48 in the Kirkfield area was being rebuilt, as was Highway 36 south of Bobcaygeon, under Contracts 79-85 and 79-32 respectively. The aggregates and asphalt for the paving mixes were all coming from Royal Paving Ltd's plant on Highway 35 north of Lindsay. Permission was obtained to put a test section of approximately one half mile length in each contract. Each contract consisted of placing a 38 cm HL-2 sand mix over a rebuilt granular base and this was covered with 38 cm of HL-4 surface mix.

The mix design used for both contracts is outlined in Tables 1 and 2.

TABLE 1

HL-2 Sand Mix	
Sand (Passing 4.75 mm)	100% wt.
Asphalt Cement 85/100	7.2% wt.
Marshall Flow	12.7 $in.^{-10}$
Marshall Stab.	1410 lb.
VMA	18.6 % vol.
Voids (75 flow Marshall)	3.5 % vol.

TABLE 2

HL-4 Surface Mix	
Stone (Ret. 4.75 mm)	45% wt.
Sand (Pass 4.75 mm)	55% wt.
Asphalt cement (85/100)	5.3 wt.
Marshall Flow	9.3 $in.^{-10}$
Marshall Stab.	1950 lb.
VMA	13.9 % vol.
Voids (75 Flow)	2.9 % vol.

In order to obtain the maximum benefit from the addition of rubber it was recommended by Professors Piggott and Woodhams that the asphalt content of the mix be increased. The recommended increase was as follows: the 5.3%, asphalt cement called for in the design should be increased to 7.0%, to which a further 20% of this weight would be ground rubber. Thus to 1000 lb. of aggregate there would be added 70 lb. of asphalt cement and 14 lb. of ground rubber. It was recommended no change be made in asphalt content of the HL-2 sand mix.

It was decided to lay two asphalt contents on each of the two contracts. One section would be laid using the mix design asphalt content plus 20% by weight rubber (Surface 1), and the other section would be at the recommended increased asphalt content plus 20% by weight of rubber (Surface 2). This was done in order to see if rubber would provide some extra desired properties at normal asphalt contents, instead of having to increase the asphalt content, which would further increase the construction cost.

2.1/ Construction of The Test Roads

The rubber crumb used came from Goodyear's tire shredding plant at Bowmanville. It was packaged in black polyethylene bags in a weight suitable so that an even number of bags would be added to each batch in the pugmill. The mixing procedure used was to add the sand and stone to the mill and dry mix as usual. Then the required number of bags of rubber crumb were cut and the rubber poured into the pugmill through a chute. This was mixed for 20 s and then the asphalt was added and mixed for the usual 25 s.

Due to a misunderstanding in the field, the first test road (Kirkfield) was under-asphalted. Instead of using the design asphalt content plus rubber, the total fluid content was kept as specified and the asphalt content reduced to accommodate the rubber. This was done for both the design, Surface 1, and increased asphalt content, Surface 2, sections. The Bobcaygeon contract was, however, asphalted as required.

The asphalt and rubber contents for the HL-2 and HL-4 lifts for both test roads were as shown in Table 4, while Table 3 shows the particle gradation for the crumb rubber.

TABLE 3

BINDER CONTENT

% wt.

Sieve Size	Percentage Passing
20	95-100
30	70-100
35	50- 85
40	35- 70
50	0- 40

TABLE 4
BINDER CONTENT
% wt.

Contract	Components	Control		Rubberized Asphalt		
		HL-2	HL-4	HL-2	HL-4 Surf. 1	HL-4 Surf. 2
79 -85	Asphalt	7.2	5.3	5.8	4.3	5.6
Kirkfield	Rubber	0.0	0.0	1.4	1.5	1.4
	Total	7.2	5.3	7.2	5.3	7.0
79-32	Asphalt	7.2	5.3	7.2	5.3	7.0
Bobcaygeon	Rubber	0.0	0.0	1.4	1.1	1.4
	Total	7.2	5.3	8.6	6.4	8.4

Table 4 shows that as a result of the misunderstanding on the rubber content at Kirkfield, four different binder contents were laid in the surface mix over two contracts, but the same aggregates and asphalt cement were used on both. The study of these two test roads will show whether or not part of the asphalt can be replaced by rubber to reduce construction costs.

The Kirkfield test road was constructed in July 1980 and the Bobcaygeon road in September 1980. The only problem encountered in constructing these roads was pick-up on the wheels of the rubber tired roller. The pick-up was one of the worst ever noted. Preheating the tires did not reduce the amount of pick-up. If any of these roads are constructed again, only steel rolling should be used.

The locations of the test roads and test sections on the roads are listed in Tables 5 and 6.

The paving at Kirkfield of Surface 2 Westbound, and at Bobcaygeon, of Surface 1 Southbound, was caried beyond the rubberized HL-2 to use up the rubber crumb on hand. The HL-2 under these extensions was control HL-2 without the addition of rubber.

TABLE 5

Contract 79-85, Hwy. 48 Kirkfield

Mix	Lane	Station
HL-2 Sand Mix	Eastbound and Westbound	35+160 to 35+853
HL-4 "Surface 1"	Eastbound	35+154 to 35+564
	Westbound	35+154 to 35+580
HL-4 "Surface 2"	Eastbound	35+564 to 35+910
	Westbound	35+580 to 830

TABLE 6

Contract 79-32, Hwy 36, Bobcaygeon

Mix	Lane	Station
HL-2 Sand Mix	Northbound	397+50 - 371+50
	Southbound	397+00 - 366+50
HL-4 "Surface 1"	Northbound	382+00 - 359+50
	Southbound	383+00 - 362+70
HL-4 "Surface 2"	Northbound	395+75 - 382+00
	Southbound	397+00 - 383+00

2.2/ Discussion

After construction samples were taken from both test roads for laboratory analysis. In addition to the usual testing the resilient modulus will be determined for all of the test sections and the control sections. The results are not yet available but should be issued soon.

There is some question about the skid resistance of the high binder content test section at Bobcaygeon. This road will be skid tested this spring.

An examination of the two test roads in mid October 1980, showed that all of the pick-up on the test road at Kirkfield had been removed by traffic. The pick-up was, however, still very much in evidence on the road at Bobcaygeon.

These roads have now passed through one winter and will be carefully observed this year. Samples will be taken again for resilient modulus and other tests for comparison with the normal construction in the control sections. The low binder content sections at Kirkfield will be carefully observed for any signs of cracking, ravelling, or poor adhesion due to low binder content.

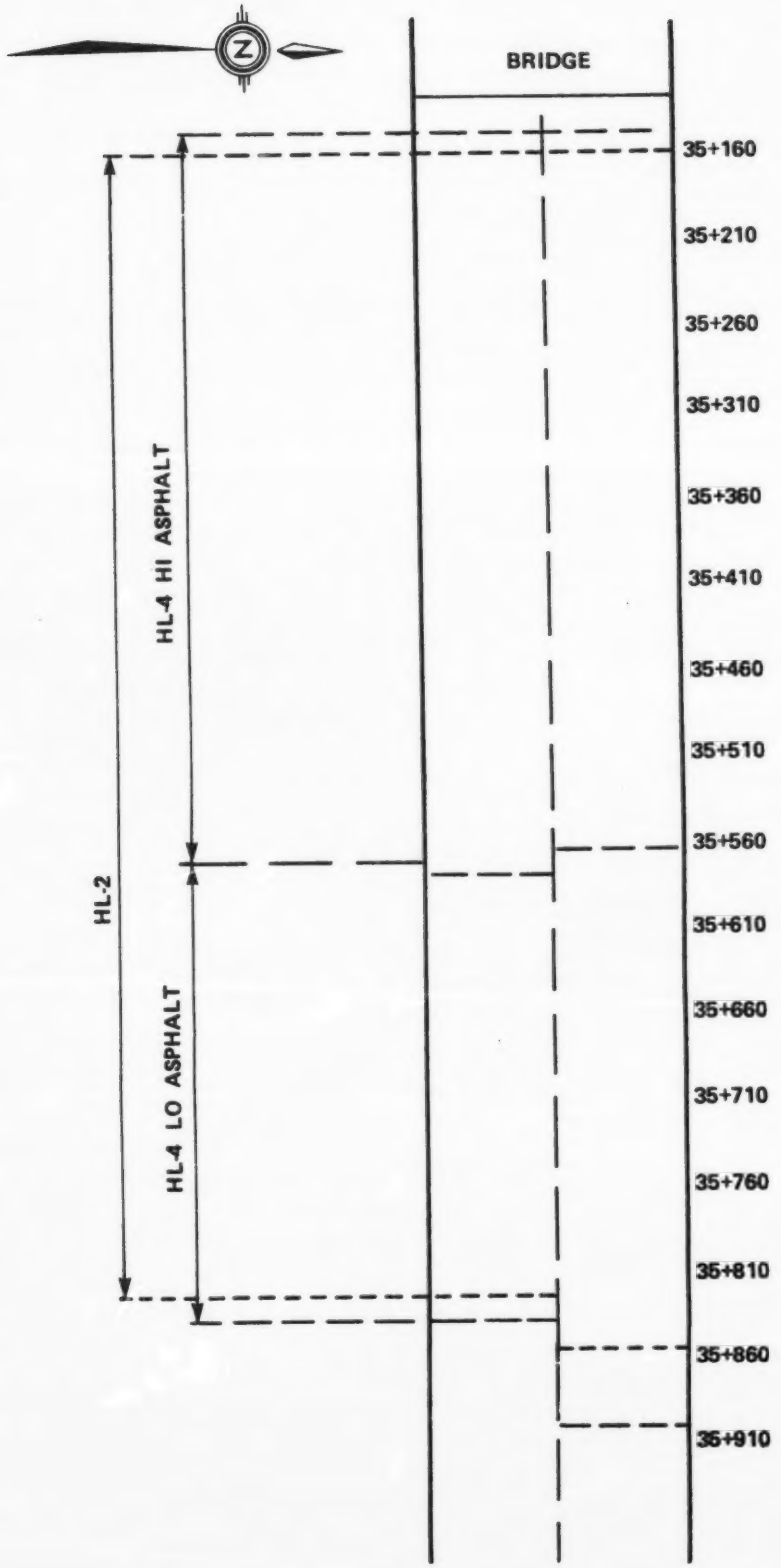

Figure 1/ Rubber Asphalt, Kirkfield, Hwy. 48, Contract 79 – 85

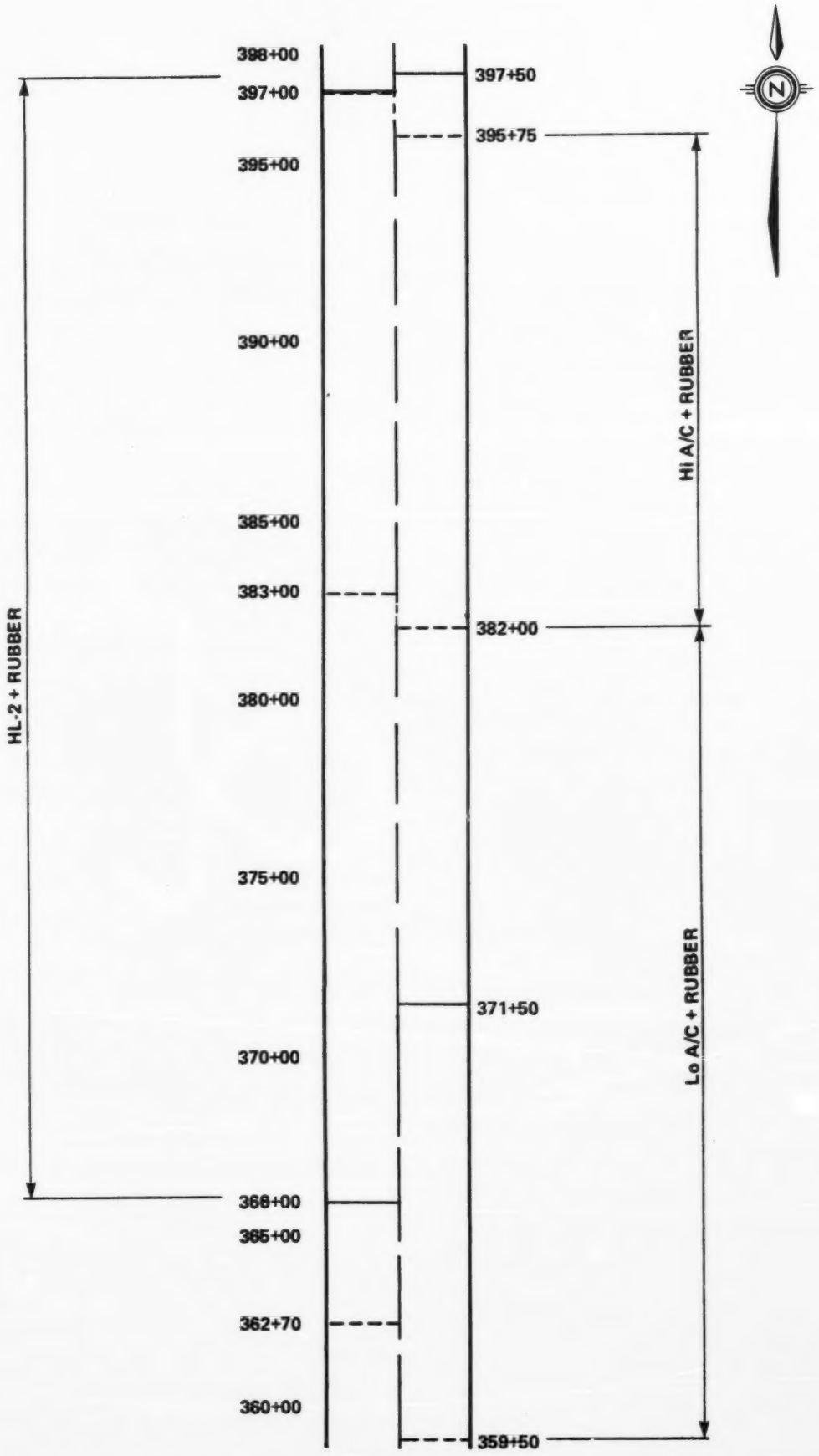

Figure 2/ Rubber Asphalt, Bobcaygeon, Hwy. 36, Contract 79 – 32

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